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Sanchirico, Jr. et al.

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(54) **ELECTROMAGNETIC DOOR SECURITY SYSTEM**

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(73) Assignee: **DynaLock Corporation**, Bristol, CT (US)

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(51) **Int. Cl.**
E05B 65/10 (2006.01)

(52) **U.S. Cl.** **70/92**; 292/92; 70/276

(58) **Field of Classification Search** ..... 292/92, 292/93, 336.3, 168, 251.5, DIG. 65; 70/92, 70/276, 277, DIG. 51; 340/542, 543, 545; 361/161, 171, 152, 139
See application file for complete search history.

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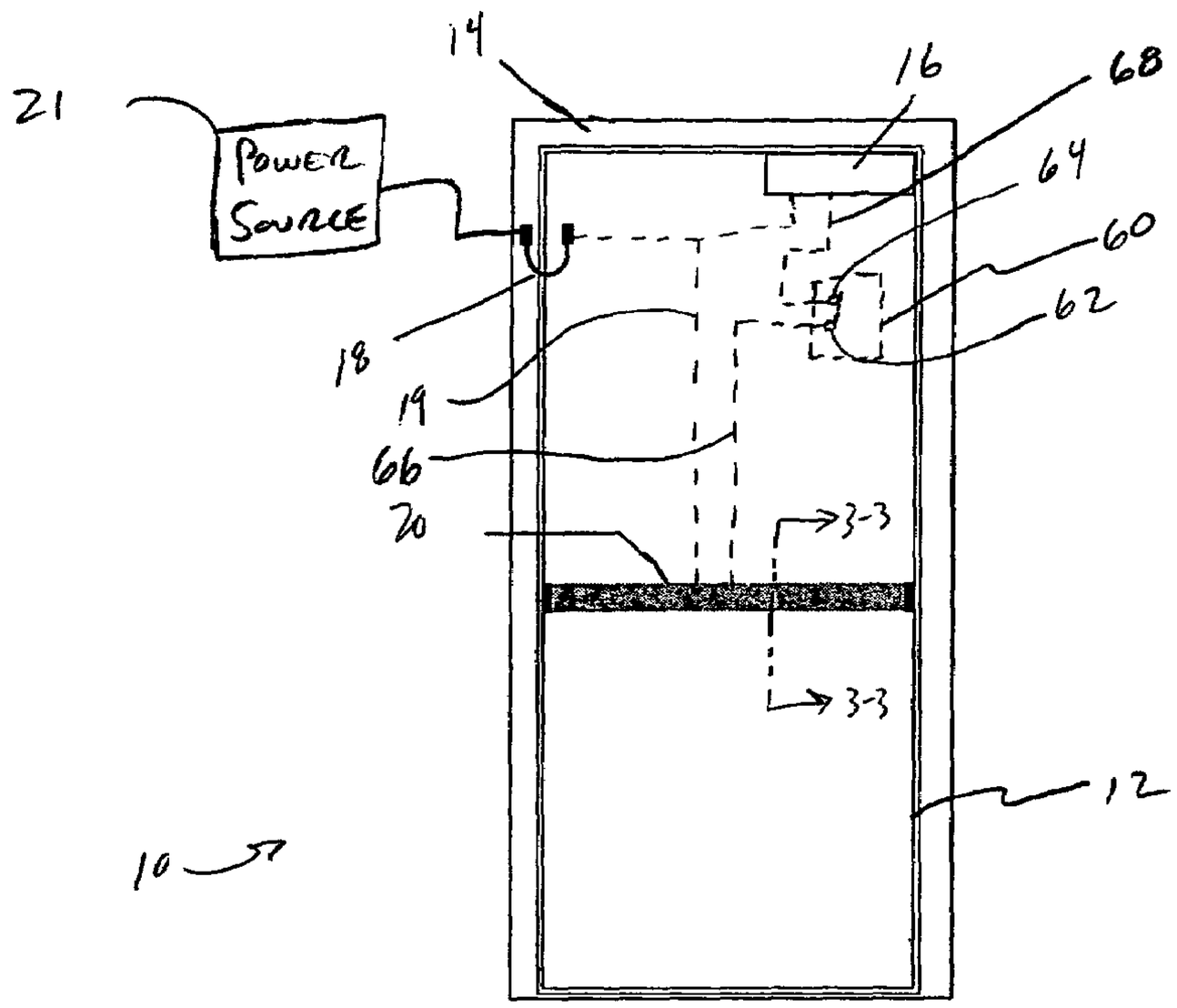
(57) **ABSTRACT**

An exit sensor bar for securing a door has an elongated housing and a mounting pad for mounting to a door. A circuit board assembly is disposed within the elongated housing in proximity to a blade of the mounting pad. The circuit board assembly includes at least an electro-optical source and an electro-optical detector coupled to a lock. The electro-optical detector selectively energizing and de-energizing the lock in response to the detection of light emitted from the electro-optical source. When a push force is applied to the elongated housing, the housing is displaced toward the mounting pad such that the blade obstructs light emitted from the electro-optical source. In response to the non-detection of the emitted light, the electro-optical detector de-energizes the lock freeing the door for egress.

9 Claims, 4 Drawing Sheets



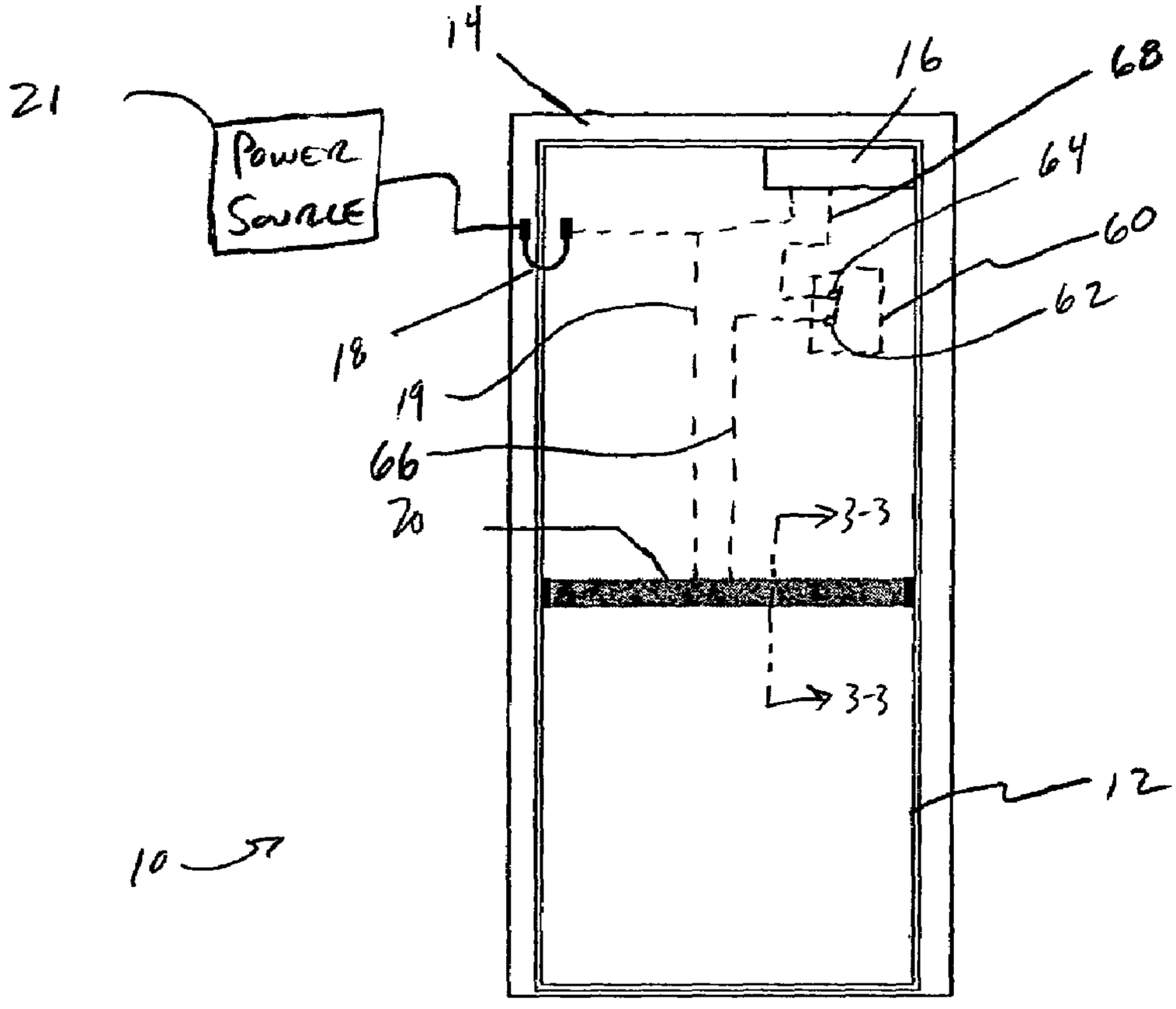

14
16
68
21
POWER SOURCE
64
60
62
18
19
66
20
3-3
3-3
12
10

FIG. 1

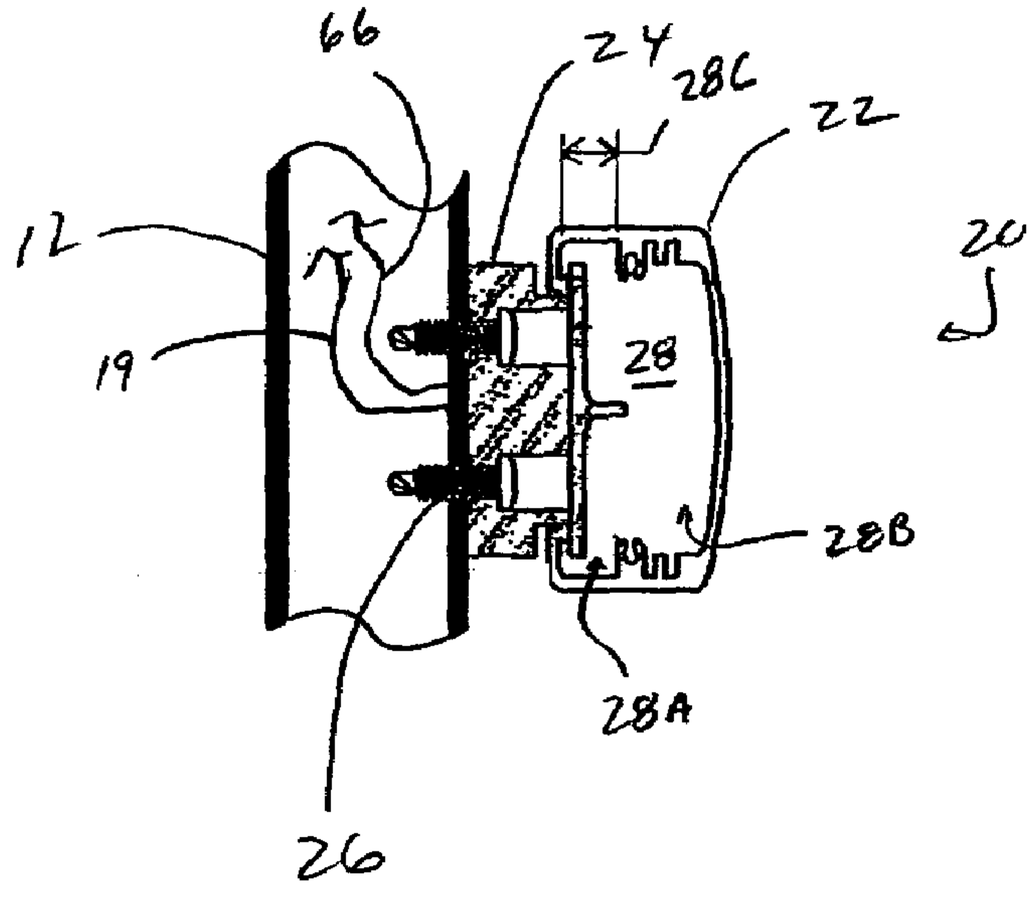

66
24
28C
22
12
20
19
28
28B
28A
26

FIG. 3

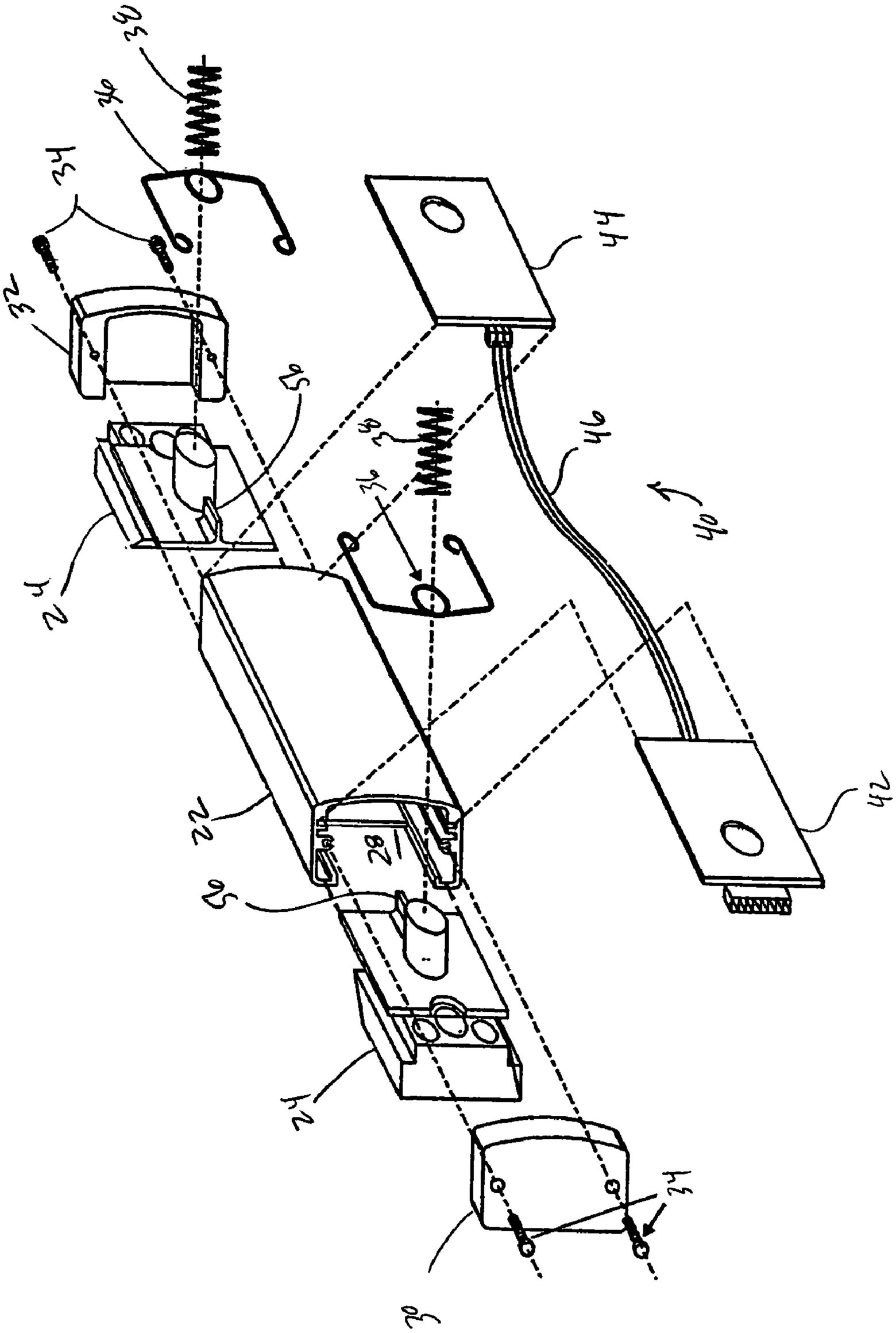


Fig 2

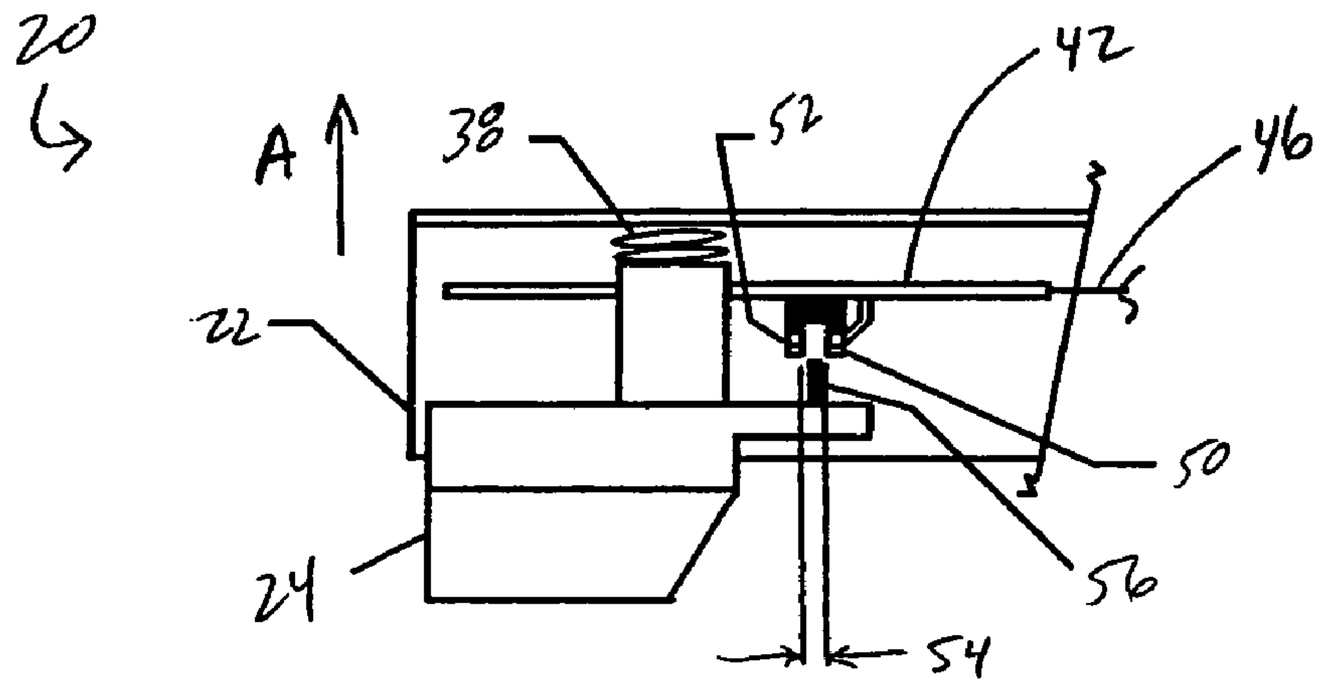


FIG. 4A

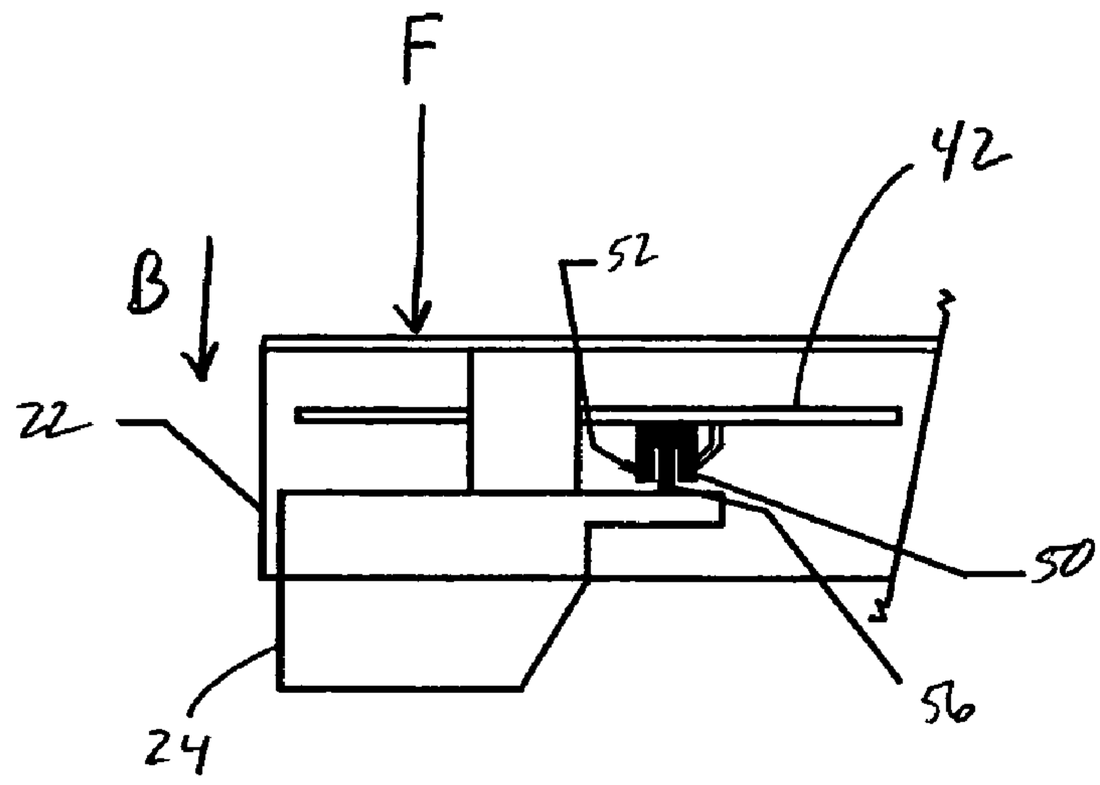
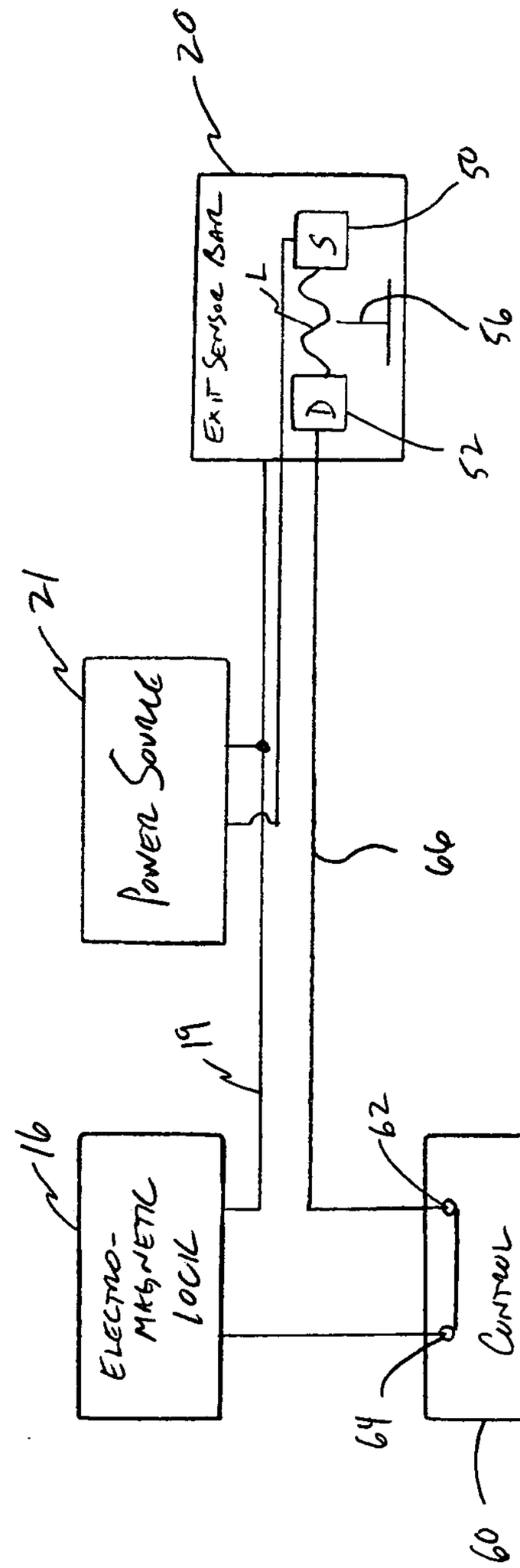


FIG. 4B


20
Exit Sensor Bar
S
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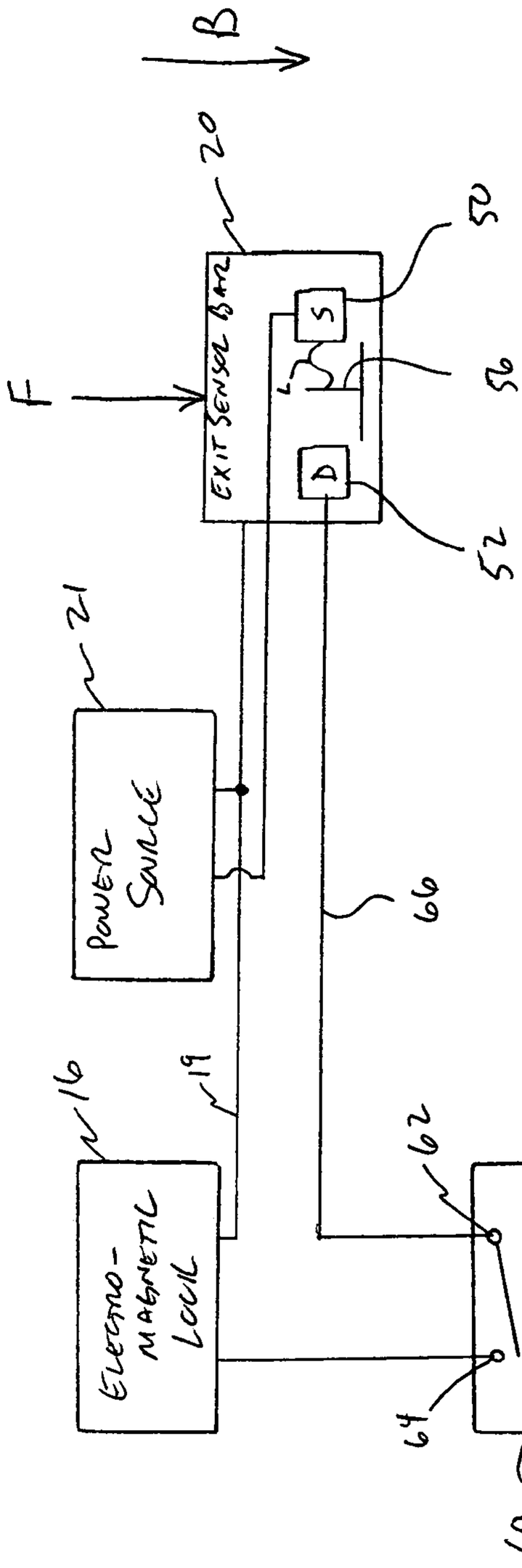
56
52
21
Power Source
19
16
Electro-Magnetic Lock
62
64
Control Relay
60
66

Fig. 5A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Electro-Magnetic Lock
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Control Relay
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Fig. 5B

ELECTROMAGNETIC DOOR SECURITY SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This patent application claims the benefit under 35 U.S.C. §119(e) of U.S. Provisional Patent Application Ser. No. 60/560,345, filed Apr. 7, 2004, the disclosure of which is incorporated by reference herein in its entirety.

FIELD OF THE INVENTION

The present invention is directed to door security systems and, more particularly, to the use of a push or exit bar for securing a door equipped with an electromagnetic lock.

BACKGROUND OF THE INVENTION

Push bars or exit bars which allow egress through a doorway while limiting ingress are well-known components of door security and emergency systems. Conventional exit bars are mounted on an interior side of a door to be secured and are oriented generally horizontally across the face of the door. A push force exerted on the push or exit bar in the direction of the interior side of the door operates a door latch to permit opening of the door. Conventional exit bars typically employ a mechanical linkage to actuate the door latch mechanism for unlatching the door. Exit bars may also employ mechanical locks to secure the door from opening. A handle can also be provided on an exterior face of the door to actuate the door latch mechanism and allow ingress under certain circumstances. Exit bars have also been connected to alarm systems and/or monitoring devices to warn security personnel of a door opening.

Conventional exit bar systems exhibit a number of deficiencies. For example, mechanical components typically require a substantial amount of adjustment at initial installation and periodic maintenance to ensure proper functioning. Additionally, during periods of high traffic levels through a doorway, mechanical latch mechanisms of a conventional exit bar can experience a high rate of wear.

Thus, there is a need for an improved door security system and, in particular, a door security system employing a non-mechanical latching mechanism.

SUMMARY OF THE INVENTION

One preferred embodiment of the present invention provides an exit sensor bar for mounting to a door. The door is operable between a locked and unlocked condition by selective energizing and de-energizing an electromagnetic lock affixed to the door and a door frame. The exit sensor bar includes a mounting pad for affixing the exit sensor bar to the door. The mounting pad includes a blade extending away from the mounting pad. The sensor bar also includes an elongated housing having an interior chamber. The interior chamber has a first portion for receiving the mounting pad and a second portion. At least one return spring is disposed on the mounting pad and within the interior chamber for biasing the elongated housing in a direction away from the mounting pad.

The sensor bar further includes a circuit board assembly disposed within the second portion of the interior chamber in close proximity to the mounting pad. The circuit board assembly includes at least an electro-optical source and an electro-optical detector coupled to the electromagnetic lock.

The electro-optical detector is disposed a distance away from the electro-optical source to define a transmission path for light emitted from the electro-optical source. The electro-optical detector selectively energizes and de-energizes the electromagnetic lock in response to the detection of the emitted light. In operation, when a push force is applied to the elongated housing, the elongated housing is displaced toward the mounting pad such that the blade of the mounting pad traverses the transmission path obstructing light emitted from the electro-optical source so that the emitted light is not detected by the electro-optical detector. In response to the non-detection of the emitted light, the electro-optical detector de-energizes the electromagnetic lock permitting egress through the door.

The exit sensor bar also preferably includes a relay operatively coupling the electro-optical detector and the electromagnetic lock. The relay is selectively energized and de-energized by the electro-optical detector for energizing and de-energizing the electromagnetic lock.

In certain embodiments, a security system for a door is provided. The door is mounted to a door frame that is installed in a building structure. The security system includes a lock mounted to the door. The lock is selectively operable between a first condition, in which the door is retained in a fixed position to the door frame, and a second condition, in which the door is released for displacement away from the door frame. The security system also includes a relay coupled to the lock. The relay is selectively energized to provide a first signal to the lock for operation in the first condition and de-energized to provide a second signal to the lock for operation in the second condition.

The security system also includes a sensor bar mounted to the door and operatively coupled to the relay. The sensor bar includes a pair of mounting pads for affixing the sensor bar to the door, where at least one of the pair of mounting pads including a blade extending away from the at least one mounting pad. The sensor bar includes an elongated housing having an interior chamber. The interior chamber has a first portion for receiving the mounting pads and a second portion. A pair of return springs are disposed on the mounting pads and within the interior chamber for biasing the elongated housing in a direction away from the mounting pads. The sensor bar also includes a circuit board assembly disposed within the second portion of the interior chamber in close proximity to the at least one mounting pad. The circuit board assembly includes at least an electro-optical source and an electro-optical detector coupled to the relay. The electro-optical detector is disposed a distance away from the electro-optical source to define a transmission path for light emitted from the electro-optical source. The electro-optical detector selectively energizes and de-energizes the relay to provide at least one of the first and second signals in response to the detection of the emitted light. In operation, when a push force is applied to the elongated housing, the bias of the return spring is overcome and the elongated housing is displaced toward the mounting pads such that the blade of the at least one mounting pad traverses the transmission path obstructing light emitted from the electro-optical source so that the emitted light is not detected by the electro-optical detector. In response to the non-detection of the emitted light, the electro-optical detector de-energizes the relay.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the present invention are better understood when the Detailed Description of the

Preferred Embodiments given below is considered in conjunction with the following figures.

FIG. **1** is a schematic view of a door security system configured and operating in accordance with one embodiment of the present invention.

FIG. **2** is an exploded view of an exit sensor bar assembly configured and operating in accordance with one embodiment of the present invention.

FIG. **3** shows a cross-sectional view of the exit sensor bar of FIG. **2** taken along lines **3**—**3** of FIG. **1**.

FIGS. **4**A and **4**B show a side, partially cross-sectional view of the exit sensor bar assembly illustrating actuation of the exit sensor bar assembly in response to an applied push force.

FIGS. **5**A and **5**B depict simplified block diagrams of the door security system of FIG. **1** illustrating an electrical circuit connection of the door system at rest and at actuation.

In these figures, like structures are assigned like reference numerals, but may not be referenced in the description of all figures.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. **1** illustrates a door security system **10** configured and operating in accordance with one embodiment of the present invention wherein the door security system **10** includes an exit sensor bar **20** such as, for example, a non-latching model 6450 Exit Sensor Bar of DynaLock Corporation (Bristol, Conn. USA), assignee of the present invention, mounted in a horizontal position across an interior side of a door **12**. The door **12** is mounted to a door frame **14** of a building structure (not shown) through which egress is to be monitored and/or controlled. An electromagnetic lock **16** such as, for example, a 3000 Series electromagnetic lock of DynaLock Corporation, is mounted to a portion of the door **12** and the door frame **14** for selectively controlling egress through the door **12**.

As shown in FIG. **1**, a cable **18** extends from the door frame **14** to the door **12** to provide power (over line **19**) from an external power source **21** (e.g., a 12 to 24V AC-DC power supply such as a 5025 series solid state power supply of DynaLock Corporation) for operating the electromagnetic lock **16** and the exit sensor bar **20** of the door security system **10**. The door security system **10** includes a control relay **60** operatively coupling the exit sensor bar **20** and the electromagnetic lock **16**. The control relay **60** includes contacts **62** and **64** that are held closed when the control relay **60** is energized and open when the control relay **60** is de-energized. When the contacts **62** and **64** are closed, a circuit (represented by lines **66** and **68**) is complete and the electromagnetic lock **16** is energized. As is generally known in the art, when energized the electromagnetic lock **16** generates a magnetic field of sufficient holding force (e.g., about fifteen hundred pounds) to retain the door **12** to the door frame **14**. As described in detail below, when depressed the exit sensor bar **20** de-energizes the control relay **60** (e.g., opens contacts **62** and **64**), which in turn de-energizes the electromagnetic lock **16**, terminating the magnetic field and releasing the door **12** from the door frame **14** so that it may be opened.

In one embodiment, the control relay **60** is coupled to a key switch or card reader such as, for example, a 7200 series digital entry keypad of DynaLock Corporation (not shown), located on the exterior side of the door **12** and operated independent of the exit sensor bar **20** to de-energize the electromagnetic lock **16** and open the door **12**. In one embodiment, the door security system **10** is coupled to other security and/or monitoring systems through the cable **18**. For example, the cable **18** provides a communication link from the door security system **10** to the other security and/or monitoring systems for monitoring operation of the door security system **10** as needed.

FIG. **2** is an exploded assembly view of the exit sensor bar **20** in accordance with one embodiment of the present invention. FIG. **3** is a partial cross-sectional view of the exit sensor bar **20** mounted to the door **12**. As shown in FIGS. **2** and **3**, the exit sensor bar **20** includes an elongated housing **22** that receives and is mounted to a pair of mounting pads **24** having openings which receive fasteners **26** for securing the exit sensor bar **20** to the door **12**. The elongated housing **22** defines an interior channel **28** having a first **28**A and a second portion **28**B. As described below, the elongated housing **22** is traversely displaceable along a height **28**C of the first portion **28**A of the interior channel in directions toward and away from the mounting pads **24**. The second portion **28**B of the interior channel **28** receives components of the exit sensor bar **20**. It should be appreciated that the elongated housing **22** may be comprised of one of a plurality of lengths sufficient to substantially span a plurality of doors each having a different width.

The interior channel **28** is terminated at opposing ends of the elongated housing **22** by end caps **30** and **32**, respectively. In one embodiment, the end caps **30** and **32** are secured to the elongated housing **22** by fasteners **34**. In another embodiment, the end caps **30** and **32** may be affixed to the housing **22** by frictional engagement. In one embodiment, the internal channel **28** is terminated by a back plate (not shown) disposed between the pair of mounting pads **24**. Preferably, the end caps **30** and **32**, mounting pads **24** and back plate substantially prevent contaminants from entering the internal channel **28** and/or prevent unauthorized access to components of the exit senor bar **20** disposed within the channel **28**. In one embodiment, the elongated housing **22**, the mounting pads **24** and the end caps **30** and **32** are constructed of metal components to provide a relatively high resistance to abuse, damage, fire and/or vandalism.

The exit sensor bar **20** includes a pair of anti-rattle springs **36** and a pair of return springs **38**. As shown in FIG. **4**A, each of the return springs **38** biases the elongated housing **22** within the first portion **28**A of the internal channel **28** in a direction (illustrated by arrow A) away from the mounting pads **24** and the door **12** such that the elongated housing **22** is disposed at substantially the full height **28**C of the first portion **28**A. Referring again to FIG. **2**, the exit sensor bar **20** also includes a circuit board assembly **40** disposed within a second portion **28**B of the interior channel **28**. In one embodiment, the circuit board assembly **40** includes a hinge end circuit board **42**, a latch end circuit board **44** and a wiring harness **46** coupling the hinge end circuit board **42** and the latch end circuit board **44**. As shown in FIGS. **4**A and **4**B, the hinge end circuit board **42** includes an electro-optical source **50** and an electro-optical detector **52** disposed a distance away from the electro-optical source **50**. The distance away defines a transmission path **54** of light (e.g., infra-red light) emitted from the electro-optical source **50** and received by the electro-optical detector **52**. In accordance with the present invention, when the transmission path **54** is unobstructed (FIG. **4**A) the electro-optical detector **52** detects the light emitted from the electro-optical source **50**.

In one embodiment, the circuit board assembly **40** in enclosed in a sealed housing or compartment, as is generally known in the art, disposed within the second portion **28**B of the interior channel **28**.

It should be appreciated that the latch end circuit board **44** is configured in a substantially similar manner as the hinge end circuit board **42** illustrated in FIGS. **4**A and **4**B. The inventors have realized that this dual sensor configuration provides improved reliability while minimizes maintenance costs typically associated with conventional mechanical latch systems. It should also be appreciated, however, that it is within the scope of the present invention to employ only one of the hinge end and latch end circuit boards **42** and **44** within an embodiment of the inventive door security system **10**.

The mounting pad **24** includes a blade **56** disposed in close proximity to and extending from the mounting pad **24** toward the transmission path **54**. When a push force F is applied to the elongated housing **22** in a direction (illustrated by arrow B) toward the mounting pad **24** by a person seeking egress through the door **12**, the bias of the return springs **38** is overcome, the elongated housing **22** is displaced toward the mounting pad **24** (in the direction illustrated by arrow B). As the elongated housing **22** approaches the mounting pad **24**, the blade **56** traverses the transmission path **54**. As shown in FIG. **4**B, when the blade **56** traverses the transmission path **54**, the electro-optical detector **52** no longer detects the light emitted from the electro-optical source **50**.

FIGS. **5**A and **5**B depict simplified block diagrams of the door security system **10** illustrating the electrical circuit of the door system **10** at rest, e.g., when no push force F is applied to the exit sensor bar **20** (FIG. **5**A), and at actuation, e.g., when the push force F is applied to the exit sensor bar **20** (FIG. **5**B). As shown in FIGS. **4**A and **5**A, when no push force F is applied, light L emitted from the electro-optical source **50** is detected by the electro-optical detector **52**, e.g., the transmission path **54** is unobstructed. The electro-optical detector **52** energizes the control relay **60** (over line **66**) for the entire period of time that the light L is detected. As described above, the contacts **62** and **64** of the control relay **60** remain closed as the control relay **60** remains energized. Since the contacts **62** and **64** are held closed, the control relay **60** energizes the electromagnetic lock **16** (over line **68**). The electromagnetic lock **16** therefore, generates the magnetic field to hold the door **12** closed against the door frame **14**.

As shown in FIGS. **4**B and **5**B, when the push force F is applied, light L emitted from the electro-optical source **50** is not detected by the electro-optical detector **52** since the transmission path **54** is obstructed by the blade **56**. While the electro-optical detector **52** does not detect the emitted light L, the detector **52** de-energizes the control relay **60** (over line **66**). When the control relay **60** is de-energized, the contacts **62** and **64** of the control relay **60** remain open. Since the contacts **62** and **64** are open, the control relay **60** de-energizes the electromagnetic lock **16** (over line **68**). The electromagnetic lock **16** therefore, terminates the magnetic field to release the door **12** previously held against the door frame **14**.

In one embodiment, the elongated housing **22** may be displaced by applying a push force F of, for example, about fifteen pounds or less of pressure at any point along the length of the elongated housing **22**. This relatively "light touch" (e.g., minimum amount of applied push force) is preferred so that the exit sensor bar **20** may be actuated by human touch, a briefcase, a cane, hip, wheelchair, elbow, and the like, to make the door security system **10** of the present invention particularly well suited for installation in facilities conforming to the American with Disabilities Act (ADA) such as hospitals, health care facilities and the like.

It should be appreciated that the use of electro-optical sensing electronics, as described herein, eliminates perceived disadvantages associated with the use of mechanical latching movements. For example, the wear typically associated with mechanical parts is eliminated. Additionally, elimination of mechanical parts is seen to minimize calibration and alignment problems seen during initial installation and period maintenance procedures thus making the inventive door security system more efficient and less costly to maintain than conventional mechanical latched systems. It should also be appreciated that it is within the scope of the present invention to employ other source-detector arrangements, e.g. a radio-frequency transmitter and receiver, magnetic field source and detector, or the like non-mechanical means, to sense an applied push force and trigger the release of a door.

Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is contemplated that the elongated housing **22** may be of a plurality of differing length to accommodate a plurality of standard or custom door widths. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.

What is claimed is:

1. An exit sensor bar for mounting to a door, the door operable between a locked and unlocked condition by selectively energizing and de-energizing an electromagnetic lock affixed thereto, the exit sensor bar comprising:

a mounting pad for affixing the exit sensor bar to the door, the mounting pad including a blade extending away from the mounting pad;

an elongated housing having an interior chamber, the interior chamber having a first portion for receiving the mounting pad and a second portion;

at least one return spring disposed on the mounting pad and within the interior chamber for biasing the elongated housing in a direction away from the mounting pad; and

a circuit board assembly disposed within the second portion of the interior chamber in close proximity to the mounting pad, the circuit board assembly including at least an electro-optical source and an electro-optical detector coupled to the electromagnetic lock, the electro-optical detector being disposed a distance away from the electro-optical source to define a transmission path for light emitted from the electro-optical source, the electro-optical detector selectively energizing and de-energizing the electromagnetic lock in response to the detection of the emitted light;

wherein when a push force is applied to the elongated housing, the elongated housing is displaced toward the mounting pad such that the blade of the mounting pad traverses the transmission path obstructing light emitted from the electro-optical source so that the emitted light is not detected by the electro-optical detector, and in response to the non-detection of the emitted light the electro-optical detector de-energizes the electromagnetic lock.

2. The exit sensor bar as defined by claim 1, wherein the mounting pad is comprised of a pair of mounting pads and at least one of the pair of mounting pads includes the blade.

3. The exit sensor bar as defined by claim 1, further comprising:

a relay operatively coupling the electro-optical detector and the electromagnetic lock, the relay being selectively energized and de-energized by the electro-optical detector for energizing and de-energizing the electromagnetic lock.

4. The exit sensor bar as defined by claim 3, wherein the circuit board assembly is comprised of a hinge end circuit board and a latch end circuit board, each of the hinge end and latch end circuit boards includes an electro-optical source and an electro-optical detector, the hinge end and latch end circuit boards operatively coupled together by a wiring harness;

wherein the relay is operatively coupled to the electro-optical detectors of both of the hinge end and latch end circuit boards.

5. The exit sensor bar as defined by claim 1, further comprising:

a pair of end caps coupled to opposing ends of elongated housing and terminating the interior channel.

6. The exit sensor bar as defined by claim 1, wherein the electro-optical source emits an infra-red light.

7. The exit sensor bar as defined by claim 1, wherein the applied push force is greater than zero to about fifteen pounds of pressure applied at any point along the length of the elongated housing.

8. A security system for a door, the door mounted to a door frame that is installed in a building structure, the security system comprising:

a lock mounted to the door, the lock selectively operable between a first condition wherein the door is retained in a fixed position to the door frame and a second condition wherein the door is released for displacement away from the door frame;

a relay coupled to the lock, the relay being selectively energized to provide a first signal to the lock for operation in the first condition and de-energized to provide a second signal to the lock for operation in the second condition; and

a sensor bar mounted to the door and operatively coupled to the relay, the sensor bar including:

a pair of mounting pads for affixing the sensor bar to the door, at least one of the pair of mounting pads including a blade extending away from the at least one mounting pad;

an elongated housing having an interior chamber, the interior chamber having a first portion for receiving the mounting pads and a second portion;

a pair of return springs disposed on the mounting pads and within the interior chamber for biasing the elongated housing in a direction away from the mounting pads; and

a circuit board assembly disposed within the second portion of the interior chamber in close proximity to the at least one mounting pad, the circuit board assembly including at least an electro-optical source and an electro-optical detector coupled to the relay, the electro-optical detector being disposed a distance away from the electro-optical source to define a transmission path for light emitted from the electro-optical source, the electro-optical detector selectively energizing and de-energizing the relay to provide at least one of the first and second signals in response to the detection of the emitted light;

wherein when a push force is applied to the elongated housing, the bias of the return spring is overcome and the elongated housing is displaced toward the mounting pads such that the blade of the at least one mounting pad traverses the transmission path obstructing light emitted from the electro-optical source so that the emitted light is not detected by the electro-optical detector and in response to the non-detection of the emitted light the electro-optical detector de-energizes the relay.

9. The security system for a door as defined by claim 8, further comprising:

at least one of a key switch and a card reader disposed on a surface of the door opposite to a surface of the door where the exit sensor bar is mounted, the at least one of the key switch and the card reader operatively coupled to the relay for selectively energizing and de-energizing the relay independently of the exit sensor bar.

* * * * *